Microbial Production of Renewable Monoethylene Glycol

Brian Pereira, Marjan De Mey, Chin Giaw (Ryan) Lim, Haoran Zhang, Gregory Stephanopoulos

Monoethylene glycol (MEG) is an important commodity chemical with such applications as antifreeze and as a raw material for poly(ethylene terephthalate) which is utilized for plastic packaging and polyester fabric. Currently, MEG is produced in large volumes (approximately 19 million metric tons in 2010), primarily from fossil fuels. As a sustainable alternative, we propose a single-step bioprocess in which plant-derived carbohydrates are converted by engineered microorganisms into renewable MEG. Toward this goal, we have engineered novel metabolic pathways for the biological production of MEG into strains of *E. coli*. The general metabolic engineering strategy for the conversion of sugars into MEG is that pentoses are split into 2-carbon and 3-carbon compounds, hexoses are split into two 3-carbon compounds, and the respective 2-carbon and 3-carbon intermediates are independently converted into MEG. In this work, we validate these pathways and demonstrate the production of MEG from various sugars.